

COMPARISON BETWEEN FURROW AND DRIP IRRIGATION
OF MELON IN THE SÃO FRANCISCO REGION

BY

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SYNOPSIS -- In the Semi-Arid Tropic Research Center (EMBRAPA), Petrolina, PE, Brazil, an irrigation experiment with melon (Valenciano Amarelo var.) was conducted. Two methods were used: furrow irrigation, normally used in the region, and drip irrigation, a new technology that was tested, where the main objective was to determine some important factors in irrigation management.

The data have shown that the drip method of irrigation furnished the best results, at 0.7 atm soil water level and with 1 emitter per four plants.

INTRODUCTION

The São Francisco Region in Northeast Brazil has a very great potential in growing melons, due to local climate and soil characteristics that allows excellent fruit quality. When optimal fertilizer applications are given, the main factor affecting melon yields are soil moisture because of the normal water deficit.

When a solution like irrigated agriculture is proposed to the Northeast Region, it is essential to choose the exact place and the proper crop. Melons need high air temperature as well as high soil temperature, being just the cucumis specie more hard to satisfy in heat. This explain the excellent quality of melons produced in that Region.

This experiment was proposed to collect data related to the behavior of melon crop under drip and furrow irrigation methods as well as some factors related to drip irrigation management.

REVIEW OF LITERATURE

SHMUELI and GOLDBERG (1971) working in a comparison of sprinkle, furrow and trickle irrigation applied to muskmelon, found that vegetative growth was more rapid and yields were earlier and higher with the trickle method. No yield differences were detected between sprinkle and furrow irrigation. The

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increasing growth rate of muskmelon plants irrigated by trickling was mainly due to the greater number of leaves on the individual plant. The increased yield by trickling could be attributed in part to the greater number of fruit per plant which reached marketable size, and in part to the greater number of large fruit.

In a two year experiment with melons irrigated by the drip method, DAN (1974) found a trend to a higher total and early yield with lower quantities of water applied. The same results were get in relation to more and earlier fruits per plant.

During a three year experiment, 1971 to 1973, WILLARDSON, BOHN and HUBER (1974), concluded that higher yields per unit of water were obtained with drip irrigation over furrow irrigation of cantalupe cultivars, but at the expense of reduced total yield.

GOLDBERG, GORNAT and RIMON (1976) comments that the outstanding results under drip irrigation in cucurbits plants can be attributed to the following factors: the maintenance of low soil water tension favours plant development; the application of fertilizers through the drip system at frequent intervals helps increase yields and disease due to wetting the foliage during irrigation in reduced.

MATERIAL AND METHODS

The experiment was conducted in the Semi-Arid Tropic Research Center (EMBRAPA), Petrolina, PE. The soil is gross textured, alluvion type and the local climate was classified as very arid by HARGREAVES (1974). Melons of the Valenciano Amarelo variety were planted on the 6/14/76, at 1.5 x 2.0 m spacing and the cultural practices were those which are normal for this crop. A general view of the experiment is shown in Figure 1.

Furrow is the method of irrigation normally used for conducting melon crops in the Region. The experiment was designed for comparing this method to the drip irrigation technique. For the furrow irrigation, short rows 18 m in lenght, 0.2% slope, were employed in order to achieve uniform water application. The water system distribution was made also with polyethilene pipes as you can see in Figure 2, and the water applied per irrigation was metered for each treatment through automatic metric valves. This allow us to have a exactly irrigation control.

The control head of the drip system was located in front of the field and included diesel pump, fertilizer injector, sand filter, screen filter, pressure regulators, automatic metric valves and hydrometers (Figure 3). These three last components were used individually for each one drip irrigated treatment, allowing a double mettering of the water applied per irrigation. The emitter was a multiple-exit long-path type (IRRIGA), having each one four individuals microtube, and giving at 10 m working pressure, a total discharge of 13 l/h. The sistem water distribution using polietilene pipes were designed to possibilite individual water application in all treatments, independent of each one.

Manure and chemical fertilizers were given prior to planting, as is

customary in the Region. Nitrogen was added in four applications during the growing period to complete the amount indicated by soil analysis. It was applied in liquid form through the drip system and as solid in the furrow irrigation method.

The experimental design involving the two methods of irrigation and two soil water level was replicated four times in a randomized block design. Also, within the drip irrigation treatments was tested three different numbers of emitter per plant. The following treatments were set up:

- Treatment 1 - drip irrigation, soil water at 0.4 atm, 1 emitter/4 plants
- Treatment 2 - drip, 0.4 atm, 1 emitter/2 plants
- Treatment 3 - drip, 0.4 atm, 1 emitter/plant
- Treatment 4 - drip, 0.7 atm, 1 emitter/4 plants
- Treatment 5 - drip, 0.7 atm, 1 emitter/2 plants
- Treatment 6 - drip, 0.7 atm, 1 emitter/plant
- Treatment 7 - furrow, 0.4 atm
- Treatment 8 - furrow, 0.7 atm

Growth rates were determined by sampling eight plants per treatment in the fourth block each 20 days, during all the growing period. Five parcelled harvests were made during the period of September, 2 to October, 10, 1976. Mercury tensiometers in number of 16, were used for irrigation control at 15 and 30 cm depth. The irrigation time was calculated according to KELLER and KARMELI (1975), based on a wetting factor of 40%. There was no precipitation during all the growing period of the crop. Evapotranspiration rates average for 15 days period were calculated by the HARGREAVES (1974).

DISCUSSION OF RESULTS

Growth rates, determined by weighing entire plants and counting the number of leaves per plant, are presented in Figure 4. The rates were different for the two methods, with the highest from any of these three considered parameters, in the drip irrigation method. The rates were particularly high in the period between 30 to about 60 days from planting.

The analysis of Figure 5 shows a greater accumulated yield per harvesting during all the period for the drip irrigation treatments at the 0.7 atm soil water level. The increased yield by dripping can be attributed in part to the greater number of fruit as well as the greater average size of the fruits obtained in the parcelled harvests (Figure 6). The smallest values of these two parameter were obtained in the furrow irrigation at the same soil water level.

In Table 1 is presented the total production of melons expressed in Kg/ha. It was considered only three replications because the fourth one was used for vegetative growth sampling. As a cultural practice normally used in the Region, each plant was conditioned to produce only two fruits, being the flowers and small fruits eliminated continuously with plants growth. So, for a 20 useful plants per plot the total of 80 fruit was extrapolated to kg/ha.

The statistical analysis of these data as randomized blocks with eight treatments and three replications, showed that the mainly significant

difference occurred between the irrigation methods comparison when considering total yield. No significance was found in the individual analysis of each one of the parcelled harvest. Also no statistical difference was found within soil water level control for each one of the two methods of irrigation, and for the number of emitter per plant in the drip method.

The expanded statistical analysis has detected the effect of soil water level and the number of emitter per plant only in the third harvest production. This can be visualized in Figure 5 by the production increase the 0.7 atm treatments.

Considering only the general average yield of the drip and furrow treatments, respectively 11,846 and 7,941 Kg/ha, the increased yield is 49%. This consideration is made prominent for the drip irrigation method at the 0.7 atm soil water level (Figures 5 and 6). Furthermore we can say that 1 emitter per four plants is the most economical arrangement for drip system design, because this arrangement utilize only one lateral line per two rows of plants.

Fruit quality before and after a storage period was analysed and the results are showed in table 2.

CONCLUSIONS

Melon crop in the São Francisco Region, Brazil, responded differently to the method utilized for applying water. Greater growth rate and higher yields were obtained with drip irrigation over furrow irrigation. Taking into consideration irrigation management and equipment arrangement, soil water level at 0.7 atm and 1 emitter per four plants gave the best results.

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Table 1. Total yield of melons (Kg/ha)

Treatment	Repl. 1	Repl. 2	Repl. 3
1	12,327	13,195	10,147
2	10,254	10,345	10,164
3	11,736	7,621	12,597
4	11,172	14,443	12,823
5	12,717	14,640	14,090
6	9,908	15,027	10,017
7	5,170	14,581	7,434
8	6,219	9,485	4,725

Table 2. Chemical analysis of the melon fruit

Treatment	Brix		Acidity		B/A	
	0 day	20 days	0 day	20 days	0 days	20 days
1	12.8	12.6	0.16	0.20	80.0	63.0
2	12.8	12.5	0.15	0.18	85.5	69.4
3	12.1	11.8	0.14	0.18	86.4	66.0
4	12.5	12.3	0.18	0.17	69.4	72.4
5	12.3	12.4	0.14	0.17	87.8	72.9
6	12.2	11.6	0.15	0.16	81.3	72.5
7	12.2	11.5	0.12	0.16	95.8	76.2
8	12.2	11.5	0.14	0.18	87.1	63.8



Figure 1. General view of the experiment.

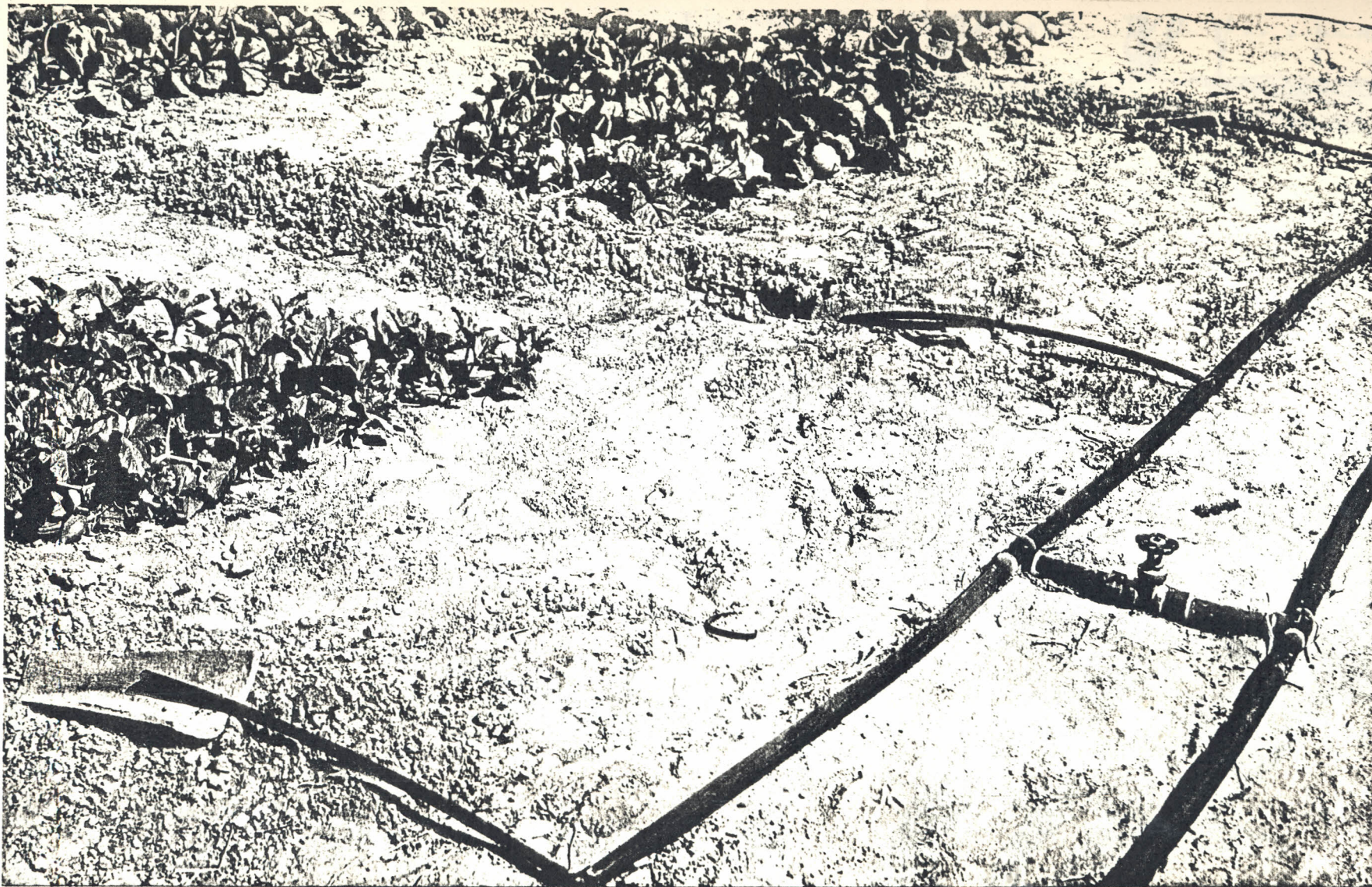


Figure 2. Water distribution system in a furrow irrigated plot.

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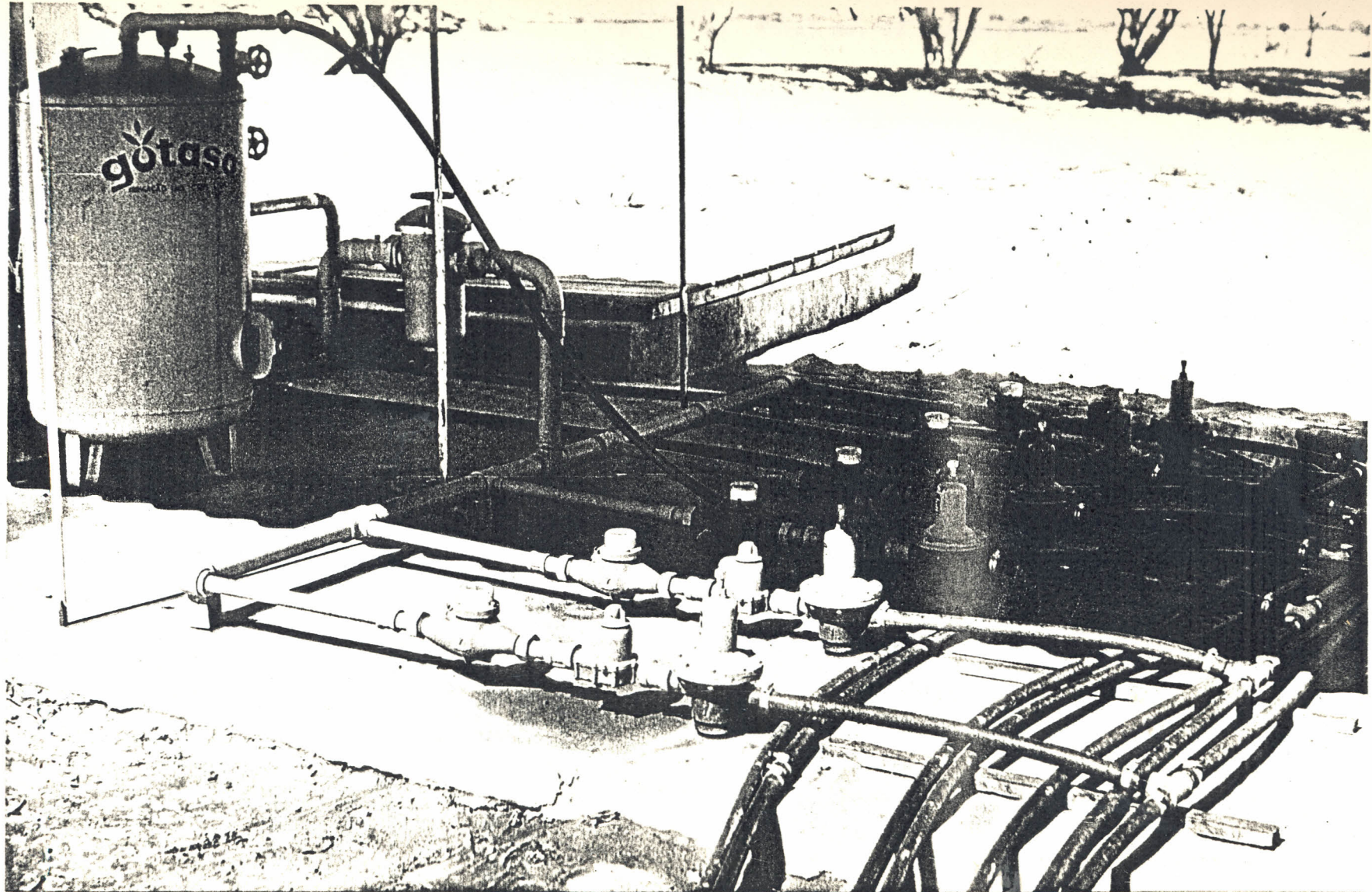


Figure 3. Control head of the drip irrigation system.

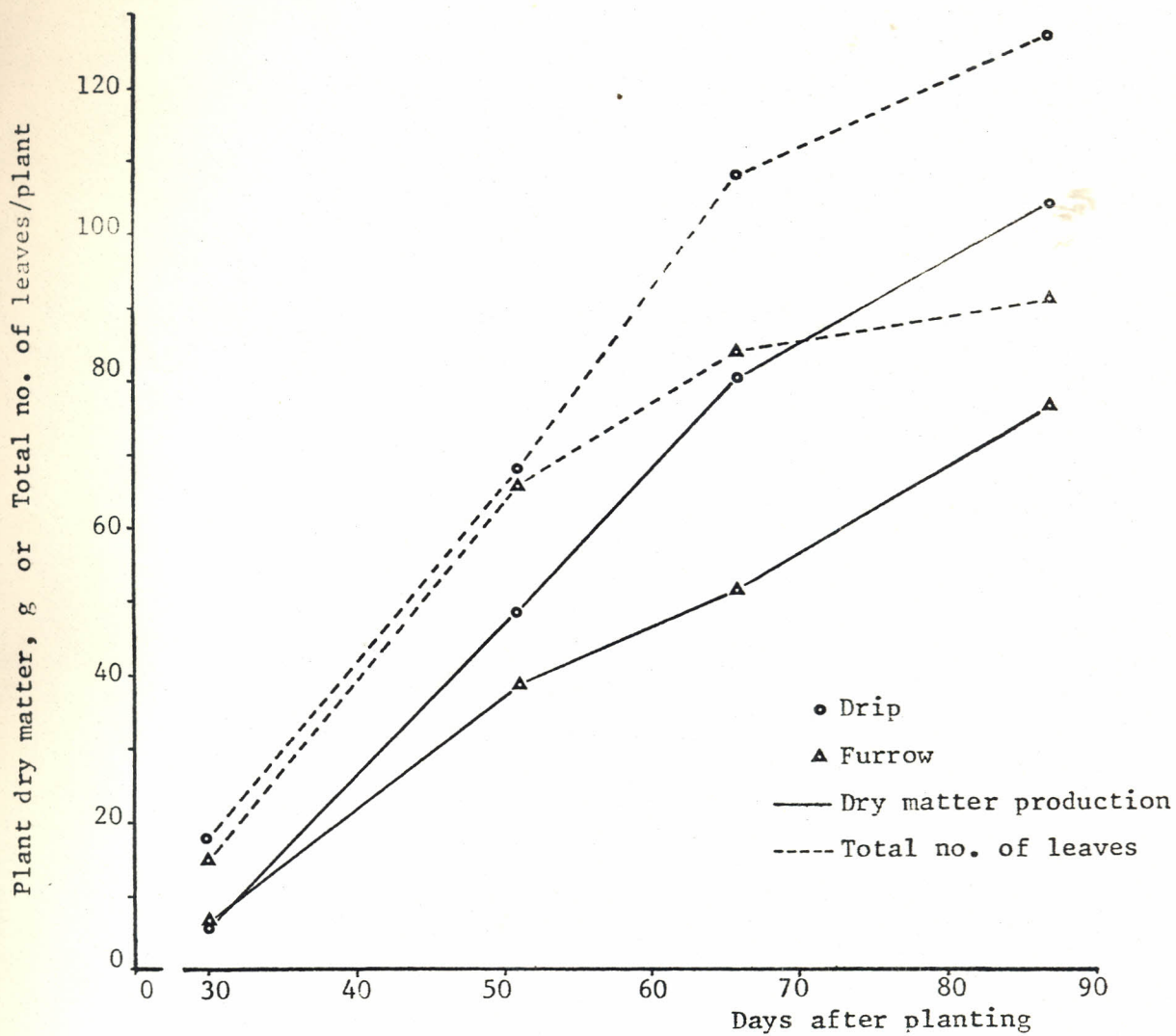


Figure 4. Melon growth rate under drip and furrow irrigation.

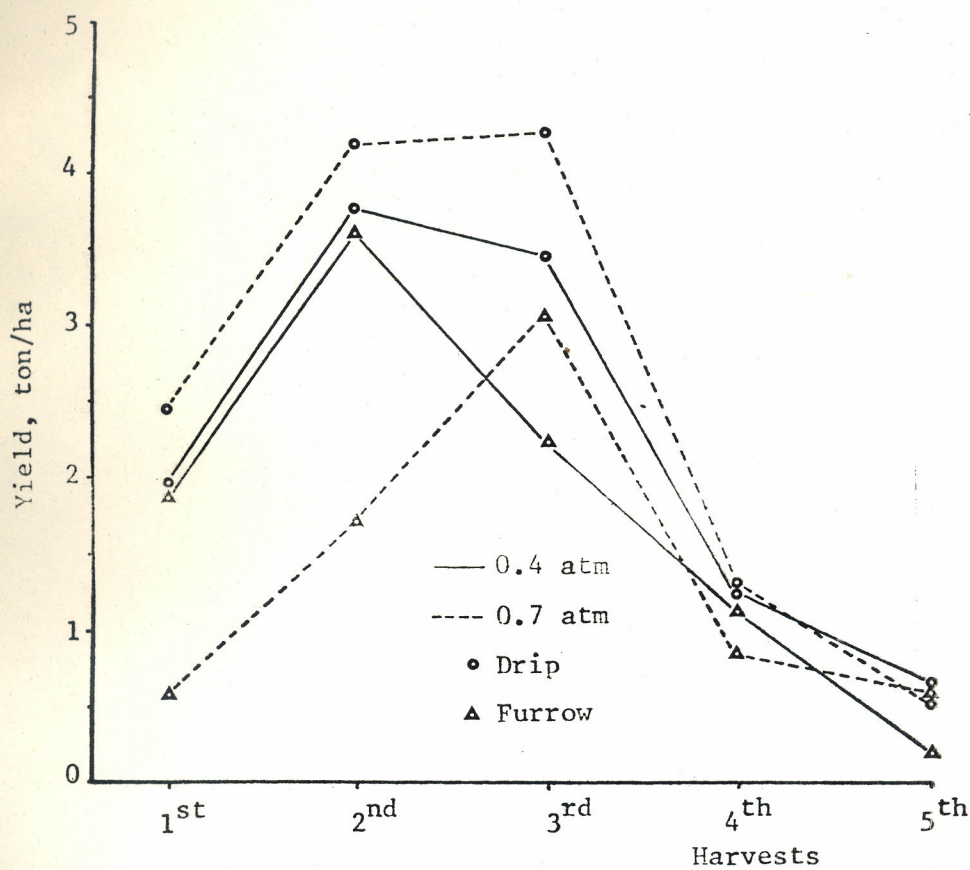


Figure 5. Average yield per harvest.

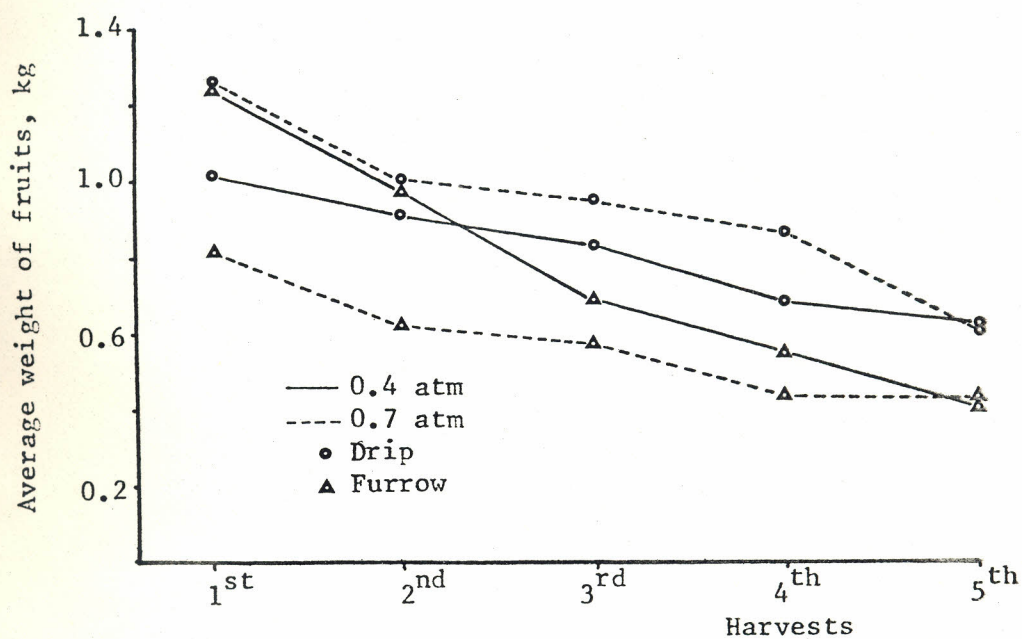


Figure 6. Average size per harvest of melon fruits.